US009292901B2

(12) **United States Patent**
Liu

(10) **Patent No.: US 9,292,901 B2**
(45) **Date of Patent: *Mar. 22, 2016**

(54) **HANDHELD DEVICE AND METHOD FOR DISPLAYING SYNCHRONOUSLY WITH TV SET**

(71) Applicant: **HUIZHOU TCL MOBILE COMMUNICATION CO., LTD**, Huizhou (CN)

(72) Inventor: **Jiang Liu**, Huizhou (CN)

(73) Assignee: **HUIZHOU TCL MOBILE COMMUNICATION CO., LTD**, Huizhou (CN)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/605,325**

(22) Filed: **Jan. 26, 2015**

(65) **Prior Publication Data**

US 2015/0138216 A1 May 21, 2015

Related U.S. Application Data

(63) Continuation of application No. 14/124,506, filed as application No. PCT/CN2012/081741 on Sep. 21, 2012, now Pat. No. 8,988,604.

(30) **Foreign Application Priority Data**

Dec. 29, 2011 (CN) 2011 1 0450532

(51) **Int. Cl.**

G06T 1/20	(2006.01)
G09G 5/00	(2006.01)
H04N 5/04	(2006.01)
H04N 7/01	(2006.01)
G06F 3/14	(2006.01)
G06T 1/60	(2006.01)
H04N 5/265	(2006.01)

(52) **U.S. Cl.**

CPC ***G06T 1/20*** (2013.01); ***G06F 3/1446*** (2013.01); ***G06F 3/1454*** (2013.01); ***G06T 1/60*** (2013.01); ***G09G 5/00*** (2013.01); ***H04N 5/04*** (2013.01); ***H04N 5/265*** (2013.01); ***H04N 7/0117*** (2013.01);

(Continued)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,288,742 B1 * 9/2001 Ansari H04N 5/232 348/14.08
2004/0239798 A1 * 12/2004 Nayar H04N 5/2355 348/362

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1848109 A 10/2006
CN 1897671 A 1/2007

(Continued)

OTHER PUBLICATIONS

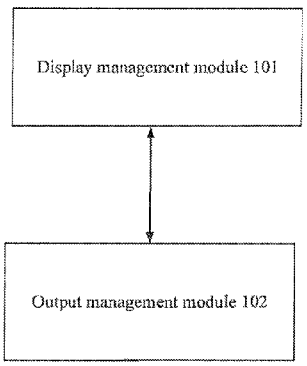
HDMI specification 1.3a, Nov. 10, 2006.*

Primary Examiner — Michael Teitelbaum
(74) *Attorney, Agent, or Firm* — Osha Liang LLP

(57) **ABSTRACT**

The present invention discloses a handheld device and a method for a handheld device to display synchronously with a TV set. The handheld device includes a display management module for converting output display data into data corresponding to a TV set screen resolution and displaying same on the TV set screen, and an output management module for converting the output display data into data corresponding to a handheld device resolution and displaying same on a handheld device screen synchronously with the TV set screen, the handheld device being connected to the TV set via an HDMI cable. A bidirectional synchronous display function is achieved in the present invention.

11 Claims, 2 Drawing Sheets



(52) **U.S. Cl.**
CPC ***H04N 7/0122*** (2013.01); *G09G 2340/0407* (2013.01); *G09G 2340/145* (2013.01); *G09G 2354/00* (2013.01); *G09G 2360/02* (2013.01); *G09G 2370/04* (2013.01); *G09G 2370/042* (2013.01); *G09G 2370/12* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0174818 A1* 7/2009 Morita G06F 3/0483 348/569
2012/0105730 A1 5/2012 Eliezerov et al.

FOREIGN PATENT DOCUMENTS

CN	201422128	Y	3/2010
CN	101727302	A	6/2010
CN	201820213	U	5/2011
CN	102231778	A	11/2011
CN	102547179	A	7/2012
CN	102572567	A	7/2012
EP	1240716	A1	9/2002
WO	2011055365	A1	5/2011

* cited by examiner

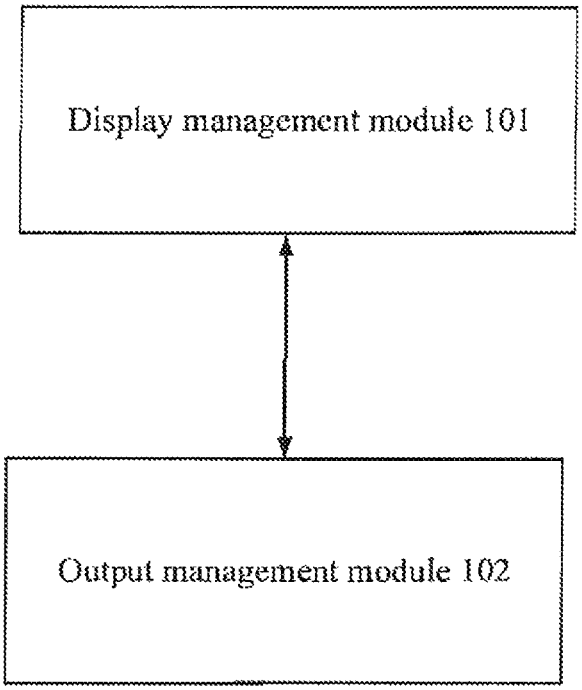

Display management module 101
Output management module 102

FIG. 1

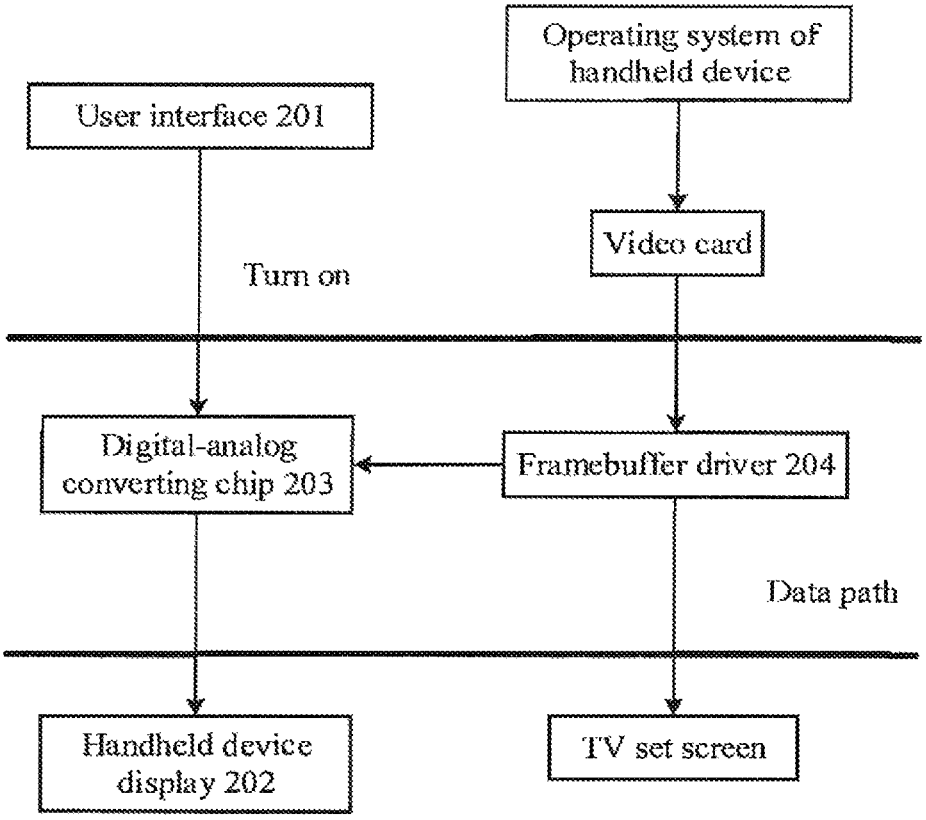

Operating system of handheld device
User interface 201
Video card
Turn on
Digital-analog converting chip 203
Framebuffer driver 204
Data path
Handheld device display 202
TV set screen

FIG. 2

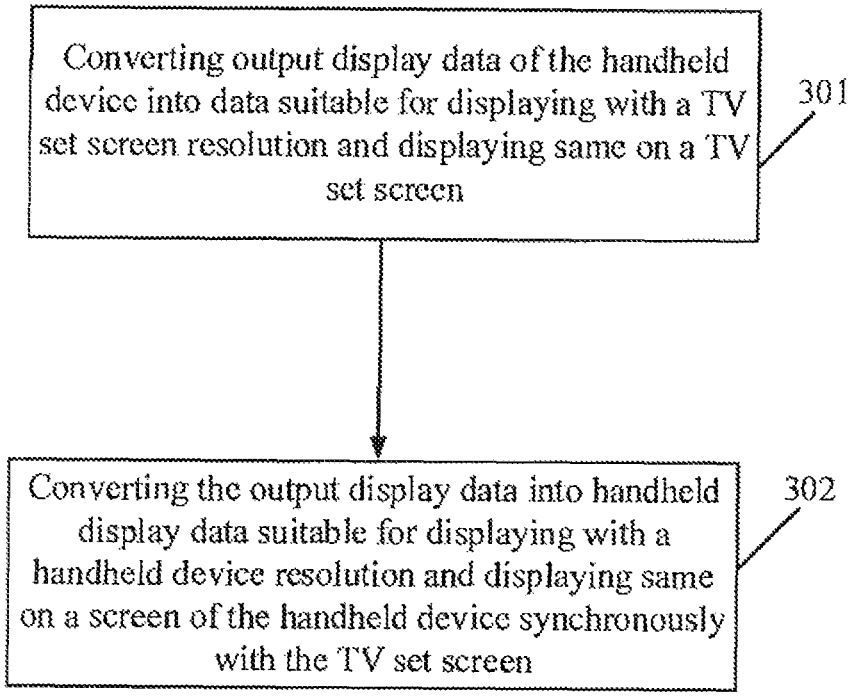

Converting output display data of the handheld device into data suitable for displaying with a TV set screen resolution and displaying same on a TV set screen
301
Converting the output display data into handheld display data suitable for displaying with a handheld device resolution and displaying same on a screen of the handheld device synchronously with the TV set screen
302

FIG. 3

HANDHELD DEVICE AND METHOD FOR DISPLAYING SYNCHRONOUSLY WITH TV SET

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 14/124,506, filed Dec. 6, 2013, the contents of which are herein incorporated by reference in their entirety.

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a handheld device and a display method thereof, and more particularly, to a handheld device and a method for a handheld device to display synchronously with a TV set.

BACKGROUND OF THE INVENTION

The display resolution of most conventional handheld devices is far lower than a standard definition, and much more difficult to achieve a higher definition. However, a user often transmits data in a handheld device to a TV set screen to display the data thereon for getting better sensory experiences. When low-resolution data are transmitted to a display device with a high resolution to be displayed thereon, unfavorable viewing effects, such as stretch and deformation, occur inevitably.

Currently, the existing synchronous display techniques for the handheld devices and TV sets in the marker are implemented by hardware. By using plural data paths, these techniques convert the data outputted from the handheld device into output signals in two or more than two paths, which are respectively outputted to the handheld device and the TV set to achieve synchronous displaying. The data path implementations comprise outputting analog signals and outputting digital signals. The former greatly reduces the cost of hardware than the latter. However, the display effect presented on the TV set screen is much worse for the former. The cost of the latter is greatly increased and this increases user's expense. Also, both implementations have a serious defect. Due to distinct resolutions, the display data outputted from the handheld device with a low resolution to the TV set screen will be stretched so as to match the big screen of the TV set. In this display method, the resolution is not increased. The original resolution of the handheld device is still retained. This exceedingly lowers the user's experiences.

As can be seen, the conventional skills need to have a further improvement and development.

SUMMARY OF THE INVENTION

To avoid above disadvantages of the conventional skills, the present invention provides a handheld device and a method for a handheld device to display synchronously with a TV set, for improving clarity of images displayed on the TV set screen, which is generated from the display data outputted from the handheld device, and for clearly displaying the output display data of the handheld device synchronously with the TV set screen.

To solve above technical problems, the schemes provided in the present invention comprises:

A handheld device comprises: a display management module for converting output display data into data that matches a TV set screen resolution and displaying same on a TV set screen, and an output management module for converting the output display data into data that matches a handheld device resolution and displaying same on a handheld device screen synchronously with the TV set screen, the display management module being in communicative connection with the output management module; the handheld device being connected to a TV set via an HDMI cable for obtaining resolution information of the TV set; the handheld device also being used for converting the output display data into data suitable for displaying with the TV set screen resolution; the handheld device also being used for selecting a dual screen display mode, obtaining standard display resolution information of the TV set screen, and initializing the handheld device according to the standard display resolution information.

Amongst, the handheld device is further used for entering the dual screen display mode when the TV set screen is connected therewith, and for preparing related display data that are to be transmitted to the TV set screen and starting an initialization process.

Amongst, the output management module comprises an user interface for operating the handheld device, a handheld device display for displaying images, and a digital-analog converting chip for converting the output display data into the data that matches the handheld device resolution, the user interface being provided on the handheld device display, the digital-analog converting chip being in communicative connection with the handheld device display.

Amongst, the digital-analog converting chip is in communicative connection with the TV set screen through a framebuffer driver of the display management module.

Amongst, the handheld device is further used for destroying an EGL database of the output display data and turning off the framebuffer driver.

Amongst, the framebuffer driver is used for transmitting high-definition display data to the digital-analog converting chip after transmitting the high-definition display data to the TV set screen, and for converting the high-definition display data into handheld display data suitable for the handheld device.

Amongst, the digital-analog converting chip is further used for compressing the output display data into the handheld display data suitable for display resolution of the handheld device.

Amongst, the user interface is further used for providing an interface for operation, and the interface is a switch motion triggered button or a switch motion triggered controller.

A handheld device comprises: a display management module for converting output display data into data that matches a TV set screen resolution and displaying same on a TV set screen, and an output management module for converting the output display data into data that matches a handheld device resolution and displaying same on a handheld device screen synchronously with the TV set screen, the display management module being in communicative connection with the output management module; the handheld device being connected to a TV set via an HDMI cable for obtaining resolution information of the TV set.

Amongst, the output management module comprises an user interface for operating the handheld device, a handheld device display for displaying images, and a digital-analog converting chip for converting the output display data into the data that matches the handheld device resolution, the user interface being arranged on the handheld device display, the digital-analog converting chip being in communicative connection with the handheld device display.

Amongst, the digital-analog converting chip is in communicative connection with the TV set screen through a framebuffer driver of the display management module.

A synchronous display method for a handheld device and a TV set, the handheld device being connected to the TV set via an HDMI cable for obtaining resolution information of the TV set. The method mainly comprises following steps:

A. converting output display data of the handheld device into data suitable for displaying with a TV set screen resolution and displaying same on a TV set screen;

B. converting the output display data into handheld display data suitable for displaying with a handheld device resolution and displaying same on a screen of the handheld device synchronously with the TV set screen.

Amongst, Step A further comprises: the handheld device destroying an EGL database of the output display data and turning off a frame-buffer driver, initializing the EGL database according to a standard display resolution of the TV set screen and then turning on the framebuffer driver, obtaining output display data corresponding to the standard display resolution, and displaying same on the TV set screen.

Amongst, Step B further comprises: the framebuffer driver transmitting the output display data to a digital-analog converting chip, the digital-analog converting chip compressing the output display data into the handheld display data suitable for display resolution of the handheld device, and displaying same on a handheld device display synchronously with the TV set screen.

Amongst, before Step A, said method further comprises: the handheld device and the TV set screen being connected to each other, the handheld device selecting a dual screen display mode, the handheld device obtaining a standard display resolution of the TV set screen, and initializing the handheld device according to the standard display resolution.

The present invention provides a handheld device and a method for a handheld device to display synchronously with a TV set, which add a display management module and a output management module as compared to conventional handheld devices. The synchronous display function is achieved by using the display management module to transmit display data, which is suitable for being displayed on the TV set screen, to the TV set screen, and then using a digital-analog converting chip to compress the display data into handheld display data suitable for being displayed on the handheld device display. That is, the display data outputted to the TV set screen is the data that has been processed by software layer and is suitable for TV set screen resolution, rather than a stretched image. This ensures clarity of the displayed images. Also, it only needs to add a digital-analog converting chip to hardware layer, and with this the high-definition display data can be compressed into the handheld display data suitable for the handheld device. The cost of hardware is greatly reduced. This ensures that the handheld device and the TV set screen are synchronized with clear images, and at the same time improves the clarity of images displayed on the TV set screen.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram showing a structure of a handheld device of the present invention.

FIG. **2** is a schematic diagram showing a detailed structure of a handheld device of the present invention.

FIG. **3** is a basic flow chart of a synchronous display method of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a synchronous display method and a handheld device thereof. To make the objectives, technical schemes, and advantages of the present invention more clear and definite, the present invention will be described further in details by using embodiments in conjunction with the appending drawings.

The present invention provides a handheld device, which records and stores audio and video clips. As shown in FIG. **1**, the handheld device comprises a display management module **101** for converting output display data into data corresponding to a TV set screen resolution and displaying same on the TV set screen, and an output management module **102** for converting the output display data into data corresponding to a handheld device resolution and displaying same on the handheld device screen synchronously with the TV set screen. The display management module **101** is in communicative connection with the output management module **102**. The handheld device is connected to the TV set via an HDMI cable for obtaining resolution information from the TV set. By the modular architecture of the display management module **101** and the output management module **102**, the handheld device and the TV set screen can display images synchronously after they are connected to each other, on the premise that the manufacturing cost of the handheld device is reduced.

In one preferred embodiment of the present invention, the output management module comprises an user interface **201** for operating the handheld device, a handheld device display **202** for displaying images, and a digital-analog converting chip **203** for converting the output display data into data corresponding to the handheld device resolution, as shown in FIG. **2**. The user interface **201** is provided on the handheld device display **202**. The user interface of the handheld device provides an interface to operate the handheld device for a user. The interface may be a switch motion triggered button or other switch motion triggered controllers. The digital-analog converting chip **203** is in communicative connection with the handheld device display **202**.

Further, the digital-analog converting chip **203** is in communicative connection with the TV set screen through a framebuffer driver **204** of the display management module **101**. After the framebuffer driver **204** transmits high-definition display data to the TV set, the high-definition display data are transmitted to the digital-analog converting chip **203**, which converts the high-definition display data into handheld display data suitable for the handheld device. This not only ensures that the TV set screen displays high-definition images, but also makes that clear images can be displayed by the handheld device.

In order to improve performance of the handheld device still further, the present invention also provides a synchronous display method for the handheld device. As shown in FIG. **3**, the method comprises following steps.

Step **301**: converting output display data of the handheld device into data suitable for displaying with a TV set screen resolution and displaying same on a TV set screen

Step **302**: converting the output display data into handheld display data suitable for displaying with a handheld device resolution and displaying same on a screen of the handheld device synchronously with the TV set screen.

Step **301** further comprises: the handheld device destroying an EGL database of the output display data and turning off a framebuffer driver **204** (EGL is an interface between OpenGL ES and the underlying native platform windowing system. Various graphics are drawn and displayed in upper layer software by EGL. Only by destroying EGL can the relation between upper layer software and lower layer hardware be broken thoroughly), initializing the EGL database according to a standard display resolution of the TV set screen

and turning on the framebuffer driver **204**, obtaining output display data corresponding to the standard display resolution, and displaying same on the TV set screen.

Further, Step **302** comprises: the framebuffer driver **204** transmitting the output display data to a digital-analog converting chip **203**, the digital-analog converting chip **203** compressing the output display data into the handheld display data suitable for the display resolution of the handheld device, and displaying same on the handheld device display synchronously, thereby achieving synchronous display function for the video and audio clips recorded in the handheld device.

Before Step **301**, the method further comprises: the handheld device and the TV set screen being connected to each other for obtaining the resolution information of the TV set, the handheld device selecting a dual screen display mode, the handheld device obtaining standard display resolution information of the TV set screen, and initializing the handheld device according to the standard display resolution information.

The handheld device and the TV set screen are connected to each other and enter the dual screen display mode. The handheld device prepares related display data that are to be transmitted to the TV set screen. At the same time, the handheld device starts an initialization process, that is, the handheld device destroys the EGL database of the output display data and turns off the framebuffer driver **204**. After that, the handheld device initializes the EGL database, that is, initializing the EGL database according to the standard display resolution of the TV set screen, and then turns on the framebuffer driver **204**, obtains output display data corresponding to the standard display resolution, and displays same on the TV set screen. The synchronous framebuffer driver **204** transmits the output display data to the digital-analog converting chip **203**. The digital-analog converting chip **203** compresses the output display data into the handheld display data suitable for the resolution of the handheld device display, and the images are displayed on the handheld device display synchronously with the TV set screen. This ensures that the handheld device and the TV set screen are synchronized with clear images, and at the same time improves the clarity of images on the TV set screen, reducing the manufacturing cost of the handheld device.

It should be understood that the above descriptions of the preferred embodiments are more detailed but the scope of the present invention must not, therefore, be limited thereto. Various modifications such as alterations and simple combinations can be made by a person skilled in this filed under the teaching of the present invention, without departing from the scope the present invention seeks to be protected. These are all falling into the protective scope of the present invention. The protective scope of the present invention is based on the range defined by the appending claims.

What is claimed is:

1. A handheld device, which is coupled with a TV set via an HDMI cable to obtain information of a screen resolution of the TV set, the handheld device comprising:

a framebuffer driver for buffering display data;

a digital-analog converting chip coupled to the framebuffer driver, for converting the display data transmitted from the framebuffer driver; and

a handheld device display receiving the converted display data from the digital-analog converting chip for displaying images;

wherein an database of the display data is destroyed and the framebuffer driver is turned off, and after that, the database is initialized according to a standard display resolution of a TV set screen and the framebuffer driver is then turned on so as to obtain the display data that matches the screen resolution of the TV set and displaying the same on the TV set screen; and

wherein the digital-analog converting chip compresses the display data transmitted from the framebuffer driver into handheld device display data that matches a handheld device display resolution and displaying the handheld device display data on the handheld device display synchronously with the TV set.

2. The handheld device according to claim **1**, wherein the handheld device provides a dual screen display mode, and the handheld device enters the dual screen display mode when the TV set screen is connected therewith and obtains standard display resolution information of the TV set screen, and then the handheld device is initialized according to the standard display resolution information and transmits the TV set display data to the TV set.

3. The handheld device according to claim **1**, wherein the handheld device destroys an EGL database of the display data and turns off the framebuffer driver when the handheld device is connected to the TV set.

4. The handheld device according to claim **3**, wherein the framebuffer driver transmits high-definition display data to the TV set screen and then to the digital-analog converting chip, and the digital-analog converting chip converts the high-definition display data into the handheld device display data suitable for the handheld device.

5. The handheld device according to claim **4**, wherein the digital-analog converting chip compresses the high-definition display data into the handheld device display data suitable for the handheld device display resolution.

6. The handheld device according to claim **5**, wherein the user interface provides an interface, which is a switch motion triggered button or a switch motion triggered controller.

7. A method for displaying images on a handheld device synchronously with a TV set, the handheld device being coupled with the TV set via an HDMI cable to obtain information of a screen resolution of the TV set, said method comprising steps of:

A. destroying an database of display data, turning off a framebugger driver, and then initializing the database according to a standard display resolution of the TV set screen and turning on the framebuffer driver so as to obtain the display data that matches the screen resolution of the TV set and displaying the same on the TV set screen; and

B. transmitting the display data from the framebuffer driver to a digital-analog converting chip; compressing the display data by the digital-analog converting chip into handheld device display data that matches a handheld device display resolution; and displaying the same on the screen of the handheld device synchronously with the TV set screen.

8. The method according to claim **7**, wherein the database is an EGL database, where EGL is an interface between OpenGL ES and an underlying native platform windowing system.

9. The method according to claim **7**, wherein before Step A, said method further comprises:

connecting the handheld device and the TV set to each other;

selecting a dual screen display mode in the handheld device; and

obtaining the standard display resolution of the TV set by the handheld device.

10. A method for displaying images on a handheld device synchronously with a TV set, in which EGL is an interface

between OpenGL ES and an underlying native platform windowing system in the handheld device and a framebuffer is a buffer in the handheld device that contains a bitmap of a complete frame of data, said method comprising steps of:

a. coupling the handheld device with the TV set to obtain a standard display resolution of the TV set screen;

b. destroying an EGL database of the handheld device and turning off a driver of the framebuffer;

c. initializing the EGL database according to the standard display resolution of the TV set screen and then turning on the driver of the framebuffer;

d. transmitting display data corresponding to the standard display resolution from the framebuffer to the TV set and displaying the transmitted display data on the TV set screen;

e. transmitting the display data from the framebuffer driver to a digital-analog converting chip;

f. compressing the display data by the digital-analog converting chip into handheld device display data that matches a handheld device display resolution; and

g. displaying the handheld device display data on a screen of the handheld device synchronously with the TV set screen.

11. The method according to claim **10**, wherein in Step a, the handheld device is coupled with the TV set via an HDMI cable.

* * * * *